Senate and House of Representatives
State of Idaho
Biotechnology Task Force

Joint Finance-Appropriations Committee Room 328
State Capitol, Boise, Idaho
September 29, 2005

Minutes
(As corrected[1] and approved by the Task Force)

The meeting was called to order at 9:30 a.m. by Cochairman Representative Doug Jones. Other committee members present were Cochairman Senator Gary Schroeder, Senator Hal Bunderson, Senator Chuck Coiner, Senator Russ Fulcher, Representative Darrell Bolz, Representative Ann Rydalch and Representative Frank Henderson. Senator Bert Marley and Representative Nicole LeFavour were absent and excused. Staff members present were Maureen Ingram and Toni Hobbs.

Other present included Ray Barnes and Melinda Hamilton, Idaho National Laboratory (INL); Jim Araji, James Nagler, Jon Van Gerpen, Matt Powell, John Hammel, Rich Garber and Gene Merrell, University of Idaho; Jack Pelton, Boise State University; Craig Herzog, Northwest Nazarene University; Phil Syrdal, BioIdaho; Michael Diamond, Monsanto; Michael Phillips and Ab Basu, BIO, Washington, D.C.; Wayne Hoffman, Idaho State Department of Agriculture; Dick Rush, Idaho Association of Commerce and Industry (IACI); Karl Tueller and Jeff Viano, Idaho Office of Science and Technology; Rachel Hall, Department of Energy; Julie Pence; Emile Loza and Julie Sommer, Technology Law Group; and Scott Pugrud, Connelly and Smyser Ltd.

After opening remarks from the cochairmen, **Representative Bolz** moved the minutes of the September 7, 2005, meeting be approved; **Representative Rydalch** seconded the motion. The minutes were approved unanimously by voice vote.

Dr. Melinda Hamilton, Division Director of Life and Earth Sciences, Idaho National Laboratory, gave some background of INL's mission explaining that it has changed over the last year with the change of contract. She said that INL is a multiprogram laboratory and that the nuclear mission is only one facet of what they do. The broader charge given to INL by the Department of Energy (DOE) includes the following:

- Leveraging science and engineering technologies to underpin DOE's missions
- Assuring the nation's energy sustainability
- Delivering nuclear research capabilities and safe testing of nuclear energy, materials and systems
- Developing solutions for the nation's critical infrastructure
- Forming national and international partnerships to address DOE's R&D needs

[1]Corrected wording: page 21, paragraph 3, first sentence, quote Rep. Henderson.

Dr. Hamilton explained that to carry out these missions, INL has launched five new, distinctive science areas where it is important to invest resources. The areas include:

< Materials and Nuclear Fuels Science and Technology
< Separations and Actinide Science
< Instrumentation, Control, and Intelligent Systems
< Modeling and Simulation of Physical Systems
< Microbiological and Geological Systems Science
< Standing up CAMS- The Center for Advanced Modeling and Simulation

Dr. Hamilton explained that this center is very important for the growth of biotech and biosciences because it relies on modeling capabilities to use the data that is being obtained. She said that INL would like to take a lead in providing those capabilities and sharing them.

Dr. Hamilton said INL has had a biotech/bioscience department for over 17 years and they have a lot of experience and capability, and are envisioning where to go next.

The laboratory has a strong geological science base and over the past years, the subsurface science has been emphasized. This brought in a lot of people including modelers, geochemists and hydrologists. **Dr. Hamilton** said it is thought that bridging biotech/bioscience with geoscience is the next step. There are a lot of problems for which biology in the subsurface or in geologic environments can provide a solution; much technology is resulting from that. Over the course of the next ten years, according to **Dr. Hamilton,** the laboratory envisions developing the capability to truly predict and control biological systems. She said many of these applications include mining, environment and agriculture.

Dr. Hamilton said that currently the Bioscience Department has:
< 30 permanent staff, and 2 to 15 students/post-docs
  -< Nine standard microbiology/wet chemistry laboratories, a greenhouse, and a high-bay for scale up
  -< Two Biosafety Level 2 certified laboratories
< Interdisciplinary Research
  -< Geosciences
  -< Physical Sciences
  -< Engineering
  -< Robotics
  -< Modeling

The disciplines represented include:
< Biology
< Microbiology
< Environmental Microbiology
< Chemical Engineering
< Molecular Biology
< Biochemistry
< Botany

< Environmental Toxicology

Dr. Hamilton said that in her opinion biotech/bioscience is the most revolutionary science taking place today. She said that INL has made a dedicated effort to keep up with the rate of change and the molecular sciences is the area where the most change is seen. The laboratory has spent $1.5 million for major equipment investment in molecular microbiology over the past 5 years including DNA sequencers, microarrays, real-time PCR and mass spectrometers.

Dr. Hamilton said that the focus of the work being done addresses energy security, environment and national security. Her presentation included specific examples of that research.

In summary, **Dr. Hamilton** stated that:

< Bioscience Department does approximately $5M R&D annually for DOE, other federal agencies, and industry
< Partnerships include other national labs, universities, and private sector
< Research focuses on national and regional issues
< Opportunities to advance biotechnology in Idaho include:
  -< Establish a regional biomining R&D center
  -< Build bioinformatics and data sharing infrastructure
  -< Revolutionize education for the next generation of biological scientists

Regarding the mining issue, **Dr. Hamilton** said that with the elimination of the Bureau of Mines a few years ago, there is no longer a central organization concerned about research for the mining industry. In her opinion, this region and Idaho is poised to take a leadership role in biotech for mining. She said it is entirely possible to establish a center that could address mining issues from environmental to actual extraction.

Representative Jones asked what is necessary to promote better information and data exchange (fiber optics or wireless) and how we get there geographically. **Dr. Hamilton** said she is not an expert but since there is not even Internet access throughout state, that would be a good place to start.

Representative Jones commented that her suggestion about revolutionizing education is something the State Board of Education and legislative germane education committees need to hear.

Senator Bunderson asked if animal waste is a consideration regarding the research being done with biofuels. **Dr. Hamilton** said that it is. She noted that more of this work is being done at the universities so INL has focused on other areas in order that the two do not overlap.

Senator Bunderson said that it is his understanding that there are tens of trillions of cubic feet of dirty gas that cannot be used because it is mixed with chemicals which renders it incompatible with other natural gas. He asked if the laboratory is involved in trying to figure out how to clean that gas for use. **Dr. Hamilton** said yes, to some extent. She said they are not actually researching how to clean the gas, but they are researching to understand the geochemical interactions that have led to the contamination and how it interacts with the subsurface in order to be able to develop the technologies to actually clean the gas. She said there is an entire fossil energy research organization that looks at just these kinds of issues.

Senator Schroeder noted the dairy odor issue Idaho faces and asked if any work is being done at the laboratory in this area. **Dr. Hamilton** said the laboratory has worked with some of the Twin Falls area dairies on that problem. The issue of dairy odor is very challenging and since microbial processes make the odor, they are looking at using the same process to control it.

In response to another question from **Senator Schroeder, Dr. Hamilton** said they have not looked into the issue of the residue from grass fields. She said that the USDA has a program looking at all types of grasses and different controls for those. As a result of that, the laboratory has intentionally not worked in this area.

Representative Rydalch asked about the prospect of education for the next generation and how involved INL is with high schools and universities. **Dr. Hamilton** said they are involved in a number of ways including offering summer internships for both high school students and college students. The high school internships involve 6 to 12 students and their teacher working at the laboratory on projects for several weeks. There are also teacher internships for all levels that allow them to work in the laboratory during the summer as well as 6 to 9 month sabbaticals. She said they also go to the schools to give presentations and demonstrations and attend science expos to promote the work they are doing and to generate student enthusiasm.

In response to another question from **Representative Rydalch, Dr. Hamilton** said there is no cohesive effort being made toward reestablishing the Bureau of Mines. There has been more interest in collaboration with other countries such as Chile because its mining industry is still supporting research.

Representative Rydalch asked if research is still being done with hard and soft rock mining. **Dr. Hamilton** said they are still doing some research in this area but the funding is just not available to support it.

Senator Coiner commented that he was impressed with range of research going on at INL. He asked, regarding the coal fired power plants being developed in Idaho, if any work is being done to extract metals from those emissions and if the current technology to do that is effective. **Dr. Hamilton** said the effectiveness of the technology varies by the particular type of technology used. She said they are involved in a number of areas including biofiltration that has actually been applied to the emissions from coal burning plants. The laboratory has also been involved in other aspects not traditionally thought of as important to the environmental impact of coal plants. These include materials research for corrosion and carbon sequestration technology. She said it is a rounded approach to the problem, not limited to emissions. **Senator Coiner** asked if that technology is put to use on a large scale. **Dr. Hamilton** said that biofiltration for organic contaminants has been installed at large levels. It is a patented technology that has been used commercially. She said that metals are another issue.

Senator Schroeder said that everyone has the ability to be good at certain things: some are good scientists while others are more creative artistically. He asked her opinion of the best way to spend our limited resources for education. Do we attempt to raise the bar in science and math for everyone or do we spend the resources on advanced placement courses for those truly interested in math and science? **Dr. Hamilton** said that in her personal opinion we have to raise the bar for everyone, not just for advanced placement. The economy is changing and in order to get industries and jobs in this country and for our children to get those jobs, the bar must be raised for everyone.

Dr. John Hammel, Dean, College of Agriculture and Life Sciences, University of Idaho, said that contrary to what some people are saying, the agriculture industry is in a time of great transition. He said there are problems and concerns but there are also technological advances to be made. He said that while today people think of agriculture as food production, in the future, crops may have multiple uses, as for food, biofuel or bioproduct. It is possible the primary crop that is taken off of the field in the future may not be as economically important as the residue that remains, which can be developed into a bioproduct.

Dr. Hammel said with the income received each year, the College of Agriculture and Life Sciences has been increasing its capability. They do this primarily by applying for competitive grants from the USDA and other major sources of revenue. Last year they had a record number of grants and contracts at over $19 million. This is about two to one for the appropriation given by the state. These grants are obtained competitively from the National Science Foundation, National Institutes of Health, USDA-National Research Initiative and the Idaho Commodity Commissions. He said this money is used to help solve the problems of Idaho.

Dr. Hammel explained that the College of Agriculture and Life Sciences has research and extension facilities located throughout the state: in Sandpoint, Post Falls/Coeur d'Alene, Moscow, Salmon, DuBois, Aberdeen, Tetonia, Idaho Falls, Twin Falls, Kimberly, Parma, Boise, Hagerman and Caldwell.

The Moscow campus contains the following:

< Animal Science Research Facilities
  -< Beef
  -< Dairy (Rapid bovine pregnancy testing)
  -< Equine (cloning mules)
  -< Sheep
< Plant Sciences Research Facilities in Moscow and Genesee
  -< Cereals (development of wheat varieties)
  -< Oil Seed Crops (canola, rapeseed and mustard)
  -< Legumes
< Agricultural Biotechnology Building
  -< PSES
  -< FST
  -< MMBB
  -< AVS
  -< Growth Chambers
  -< Microscopy
  -< Flow Cytometry
  -< Genomics/Proteomics
  -< BSL-3 Laboratory
< Biodefense Center for Emerging Diseases
  -< One of four centers funded by the National Institutes of Health
  -< $50 million award to UI & University of Washington
  -< UI/CALS - experimental vaccines development
  -< UW – animal testing
< Animal Disease Prevention
  -< Staphlococcus vaccine

- -< Major cause of mastitis in dairy cows
- -< $90 - 100 million impact on Idaho dairy industry annually

The Sandpoint Research and Extension center focuses on the following:

- < Ornamental nursery stock
- < Christmas trees
- < Small and tree fruits
- < Agroforestry

CAMBR (Center for Advanced Microelectronic and Biomolecular Research) in Post Falls deals with:

- < Molecular Biology
- < Microbiology
- < Food and Health Science
- < Electronics
- < Microprocessors
- < Radiation Electronics
- < Solid State Physics

Southwest Idaho Research and Extension Center includes:

- < Caldwell Research and Extension Center
  - -< Caine Veterinary Medical Center
    - C Animal Health
    - C Pasteurella pathogenesis
    - C TSE/scrapie research
  - -< Food Innovation Laboratory
    - C Technical and business development
    - C Small to mid-sized food companies
    - C Food entrepreneurs
    - C R&D, marketing, education and business strategy
  - -< Parma Research and Extension Center and the Caldwell Center
    - C Potatoes
    - C Cereal grains
    - C Hops
    - C Onions
    - C Corn
    - C Pomology
    - C Forage
    - C Entomology
    - C Soil sciences
    - C Range economics
    - C Livestock production economics
    - C Public land policy
    - C ARS Viticulture and Enology

Hagerman Research and Extension Center includes:

- < CALS AND CNR COLLEGES

< Aquaculture
< Fish reproduction
< Fish biology

Kimberly/Twin Falls Research and Extension Centers include:
< Dry bean research facility
< Foundation seed
< Potato storage research complex
< Sugarbeets
< Irrigation and water resources
< ARS Northwest Irrigation and Soils Research Laboratory and Sugarbeets
< Agricultural Waste Management
  -< Pilot-scale anaerobic digester
  -< Full scale demonstration digester trials
  -< Economic analysis studies
  -< Odor intensity

Aberdeen Research and Extension Center focuses on:
< Breeding/Genetics/Production/Protection
< Potatoes, Cereals, Sugarbeets, Alfalfa, Canola
< National Small Grains Germplasm Research Facility
< NRCS Plant Materials Center
< ARS Research Collaboration
< Potato Variety Development
  -< Late blight resistant
  -< Consistent quality in water-short years
  -< Long storing, resists defects and storage rot
  -< High yielding, high solids

Tetonia Research and Extension Center focuses on:
< Seed potatoes, cereal grains
< Foundation seed

DuBois Sheep Station concentrates on:
< Reproductive physiology
< Ruminant Health and Colonization
< ARS Collaboration

Nancy M. Cummings Center includes:
< Cow-Calf Research
< Forage Production
< Grazing Management

CALS priority programs in research, education and community development are:
< Sustainable crop & livestock systems
< Agricultural & food processing & product innovation

< Managing soil, air, water & biological resources
< Human health & food safety
< Animal, plant & human disease prevention
< Urban environment & small acreage agriculture
< Youth education & development
< Individual & family well-being
< Community and rural development

In response to a question from **Representative Henderson** regarding the mastitis product that **Dr. Bohach** discussed at the last meeting, **Dr. Hammel** answered that **Dr. Bohach** worked with the University of Washington to do clinical trials because that is where the facility existed. He said this product has since been patented and more studies are being done to move it towards marketability.

Representative Bolz asked what is being done or can be done to ensure the nation's food supply is safe from bioterrorism. **Dr. Hammel** said that this is an area that needs to be expanded to make detection of contamination more secure as well as being able to deal with a disease once it has been introduced to a herd or a crop.

Representative Rydalch asked if there is any part of Idaho that is being neglected in the land grant outreach programs the University of Idaho is responsible for. **Dr. Hammel** said that some of the facilities do need to be brought up to date in order to acquire grants to allow them to do certain kinds of research. He said it is a matter of infrastructure as well. He said they have lost a lot of resources including personnel because of not being up to date in certain areas.

Senator Schroeder asked what the level of the deferred maintenance costs is and what the effect of that will be five to ten years into the future if those concerns are not addressed. **Dr. Hammel** said that with the inflationary cost, this amount increases and usually costs at least two to three times as much later on. **Senator Schroeder** said that it was his assumption that if these issues are not addressed at some point, the stature of the college may be affected on a national or international level. **Dr. Hammel** agreed. He said the game is very competitive right now and resources need to be available in order for universities to compete for the high level grants and to get and keep research scientists. **Senator Schroeder** said he would like to have for the next meeting the actual amount of deferred maintenance costs. **Dr. Hammel** said he would provide them.

Representative Jones commented that he has heard the loss of a good research scientist takes 5 to 8 years to make up for by the time someone is rehired and is able to rebuild the program. **Dr. Hammel** said that is true. He said the front end investment in scientists includes the base salary, which at the University of Idaho, is about 20%-30% lower than its competitors. Secondly, there is that investment in start up costs to set up laboratory and equipment. He said that it takes two to three years for a young scientist to develop a program. During that time other universities and industry people become aware of what these scientists are doing and sometimes they too leave, and the process starts over again, making it even more costly to replace with a comparable researcher.

Dr. Matt Powell, Assistant Professor at the University of Idaho spoke for **Dr. Ron Hardy, Director of Aquaculture Research Institute at the University of Idaho. Dr. Powell** stated that the Hagerman Fish Culture Experiment Station (HFCES) is part of the University of Idaho's Aquaculture Research Institute

(ARI). It is located 90 miles southeast of Boise near Twin Falls. Seventy percent of the trout farmed for food in USA is grown within 20 miles of Hagerman Station. Research specialties at the facility include broodstock selection, feed trials and diet formulations, conservation genetics, molecular diagnostics, effluent pollution and disease detection.

Dr. Powell gave the following background information on the HFCES:

- 1996: Idaho legislature funded Director position and start-up money for UI to operate mothballed USFWS facility. This was facilitated by NSF EPSCoR funding at $50,000
- Nov '98: Property transferred to the UI thanks to Idaho's Congressional delegation
- FY00: Congress approved first USDA/ARS position at HFCES
- 2000: Idaho legislature funded laboratory operating expenses
- FY02 & 03: Congress approved two more USDA/ARS positions at HFCES (scientists hired in Fall 2003)
- Today: staff grown from 2 to 30, funding increased from $0 to $3.5 million per year, 93% from grants & contracts

The strategy for the last eight years has been:

- Define areas of specialization based on…
  - Avoiding competition with existing labs
  - Selecting areas in which there are unfulfilled needs in Idaho and region, and that connect with big issues (water, ag, endangered species, pollution, sustainability)
  - Chose programs that attract funding and collaboration
- Find interesting scientists with varied backgrounds who want to work in rural Idaho
- Build capacity and resources to create barrier of entry to competition
- Position laboratory as "go-to" place to get things done, i.e., aggressive, entrepreneurial, nationally-recognized center of expertise in strategic areas

Resources and expertise include:

- Nutritional Biochemistry
- Molecular Genetics
- Fish Pathology/Disease/Fish Immunology
- State-of-the-art molecular laboratory
- New buildings with video conferencing capabilities (June '06 completion)
- Complete experimental feed production and fish culture facilities
  - Rainbow trout, zebrafish, ornamental species, all sizes & all ages

Dr. Powell said that there are five PhDs and five technicians working in the nutritional biochemistry area. The resources for nutritional research include a $3.5 million feed production laboratory operated in conjunction with the aquaculture research service. The capabilities include extruded fish feed, ornamental fish feed and larval fish feed. These are very large production facilities that can produce diets to feed large lots of fish. The resources also include analytical laboratories for proximate analysis, fatty acids and most metabolites in animal tissues. The fish rearing facilities include the best trout research laboratory in North America, an ornamental fish laboratory and zebrafish research tanks.

The molecular genetics area includes three PhDs plus six technicians. Resources are specialized equipment for analyzation, detection and microarray, and robots for DNA/RNA extraction and for liquid handling.

A new state-of-the-art $2 million building to house the equipment and personnel is under construction, to be completed in June, 2006.

Dr. Powell said that growth of global aquaculture production requires cost effective ingredients made from sustainable ingredients like Idaho barley. This has been a major area of emphasis at the station. The goal is to:

< Increase use of proteins from grains & oilseeds
  -< Balance protein with crystalline amino acids
  -< Reduce antinutritional factors with enzyme treatment
< Reduce protein levels
  -< Recycle nutrients
< Reduce nutrient losses
  -< Attractants
  -< Physical integrity of pellet
  -< Prevent leaching through encapsulation
< Boost immune system

Dr. Powell stated that the reason for this emphasis is to try to convert the use of fish meal for fish food (which is imported) to something that is grown here in Idaho. This also evens out the market by making the price more stable. The first generation of trout selected for faster growth on barley-based diets have grown faster and are larger. Genetically-improved rainbow trout are selected based upon their molecular genetics.

The Center for Salmonid and Freshwater Species at Risk programs include:

< Genetic analysis of fisheries stocks for fisheries managers
< Real-time genetic monitoring of returning salmon from endangered chinook and sockeye populations
< Development of new genetic tests to assess disease status, fitness, and other important characteristics of wild fish populations
< Tissue archive for threatened and endangered fish species
< Functional genomics

Dr. Powell said that one of the more important questions facing endangered species issues in Idaho is hatchery/wild trout interactions between salmon or trout species. The considerations are:

< Most ESA petitions to list fish species in the western United States include hybridization with hatchery fish as a major cause of decline.
< The most controversial legal arguments for or against ESA listings or management of fish populations are whether or not hatchery fish should be considered genetically the same as a wild population.
< The USFWS and NOAA Fisheries' legal policies on hybridization are undergoing difficulty being approved by the Solicitor General's office. Thus, most all litigation now involves "hybridization" issues.
< The most widely used and scientifically accepted tool to recover critically endangered fish populations is artificial propagation in hatcheries.

Dr. Powell said that the bottom line is that these arguments are based on studies of non-DNA tested

populations and this center examines functional differences between hatchery and wild fish. This comes down to the age old biological question of nature vs. nurture and whether hatchery fish can be raised so that they are not different from their wild counterparts. The strategies include using molecular technology to assess the effect environmental conditions have on the expression of genes, and to identify specific, functional genetic differences between hatchery and wild stocks in the same environments.

To implement the strategies, it is necessary to consider reforming the hatchery environment. **Dr. Powell** coauthored the "Blueprint for Hatchery Reform" for Trout Unlimited that explains this. The idea is to close the gap between our hatcheries and the natural environment so that the hatchery fish are more wild-like. Replicated streams will be built at Billingsley Creek in Hagerman. There are some calculations that indicate up to 50 miles of engineered stream in Idaho could replace the production in all existing Idaho hatcheries.

The strategy for the next five years includes:

- To capitalize on intellectual and physical assets
- Expand from "working on fish" to "working on fundamental issues using fish as a tool"
- Expand activities using scientific base into:
  - Selected medical and developmental questions
  - Idaho's ag economy to ad value
  - Water allocation issues based on needs of fish
  - Engineered, or replicated, stream research
    - Pertains to restoration based on needs of fish, species interactions, flow, etc.
    - Engineered streams to double production of migratory salmon and steelhead from Idaho
  - Farmed fish products as functional foods for human health
  - Nanotech, or small sensing devices for fish physiology, stream ecology, etc.

Dr. Powell discussed how fish are being used in medical research:

- Diabetes
  - Fish model: insulin production regulated by two genes that are coupled in people, not coupled (separate) in fish so their function can be studied separately
- Muscle wasting in cancer/AIDS/autoimmune disease (Cachexia)
  - Old model: caused by reduced food intake coupled with higher metabolic needs
  - New model: caused by specific muscle gene inhibition and up-regulated degradation resulting from chronic immune stimulation, e.g. TNF
- Muscle growth – study genes involved in hyperplasia in fish and their regulation
  - Hypertrophy – fibers get bigger (mammals)
  - Hyperplasia – more fibers are produced throughout life cycle (FISH)
    - Key Question: What gives fish this ability and how can it be applied to human health issues?
- Immune and metabolic systems – certain fish physiology systems are similar to humans as far as they go
  - Currently we have >45 DNA probes for specific physiology pathways
  - Can measure effects of, say, diet, stress, drugs, bugs, etc. on immune system response

Dr. Powell discussed how farmed fish are functional foods for human health, all of which can be

manipulated through feeds.

< Boost selected nutrient levels in farmed fish
  -< Omega-3 fatty acids
  -< Antioxidants
< Reduce levels of pollutants in farmed fish compared to wild
  -< PCBs, mercury, etc.
< Increase or decrease fillet lipid level

Nanotechnology is used with small sensing devices for fish physiology, stream ecology, etc.

< Status: just beginning discussions with UI nanotechnolgy researchers (Dr. David McIlroy)
< Interaction fostered through NFS EPSCoR grant
< Possibilities include micro sensors in fish, streams, underground (hydrology)

Dr. Powell summarized by offering the following:

< The research platform at Hagerman is nearly in place
  -< Critical mass of scientists
  -< Complete range of equipment for biotech – molecular research
  -< Fish rearing capacity is best in the nation
  -< New building to be completed in June 2006
< We intend to use this platform in innovative ways
  -< Continue fish research in commercial aquaculture and conservation biology
  -< Expand research scope using fish as tools to study basic genetic and developmental questions
  -< Focus research capacity on questions critical to Idaho
< We will seek collaboration with other Idaho scientists, industry and agencies to utilize our strengths to expand Idaho's science base

Senator Bunderson asked with the advent of more fish farms and the recognition the facility is receiving, what role is seen in the future for the Hagerman Fish Culture Experiment Station. He asked if the plan is for the operation to take a broader role on a national scale to support fish research in other settings possibly, becoming the national laboratory for aquaculture and fish research. **Dr. Powell** said that they would like that. He said the center will have to take a broader role because fish are a more efficient source of protein with respect to their growth than other types of agricultural products such as beef or poultry. Most of the world will be feeding themselves on fish protein in the future. The aquaculture industry expects to grow tremendously within the next 10 to 20 years. **Dr. Powell** said that China's aquaculture industry alone grows more every year than the entire industry in the U.S. The U.S. has 4 feed mills for producing trout food while China has over 100 feed mills just for carp and catfish production. **Dr. Powell** said there is a tremendous opportunity for them to expand and continue to contribute scientifically.

Senator Bunderson said that part of the committee's charge is to figure out how to structure Idaho to deal with bioscience. He asked for Dr. Powell's vision of what Idaho should do to enhance biotech; should it be industry specific in one area or dispersed? **Dr. Powell** said the strategy that has been used to build this laboratory with respect to bringing in collaborators is to have one laboratory with different research groups using the facility for their own particular projects. This gives them the ability to leverage personnel and equipment and use their collective connections to expand and grow. Continued growth tends to attract more money and it now is almost growing by itself.

Representative Rydalch asked if the center is working with any private sector groups or industry people to facilitate bringing the larger barley fed fish to the market. **Dr. Powell** said they work very closely with the Idaho Aquaculture Association that holds monthly meetings in the laboratory's conference room. It is very important, in **Dr. Powell's** opinion, for them to engage the USDA in the process because they can help get information out about what the laboratory is doing so others are aware of it. It is important that the laboratory does not insulate itself.

Senator Schroeder asked for clarification of whether specific research should be concentrated in specific areas. **Dr. Powell** said that in his opinion, that has to be taken in context with why the facility is located where it is. He said he would recommend this for aquaculture because the water is available there to do the work.

Dr. Jon Van Gerpen, Department Head, Biological and Agricultural Engineering, University of Idaho, presented research being done in biofuels and explained the development of a biodiesel industry in Idaho. He said that regarding biofuels, the state has made a long-term and sustained investment in biodiesel research. The time is right for moving the technology into commercialization. Biodiesel is an alternative fuel for diesel engines that is produced by a chemical reaction between an ethanol or methanol with a vegetable oil or animal fat, creating a new product. Biodiesel can be used as a pure fuel directly into the diesel powered vehicle or it can be blended with diesel fuel in any proportion. The department has three vehicles that are run on 100% biodiesel fuel.

There are advantages and disadvantages of biodiesel:
Advantages
< Biodegradable, nontoxic, renewable
< Lower emissions, climate change neutral
< Requires no engine modifications (except replacing some fuel lines on older engines).
< High cetane number and excellent lubricity.
< Very high flashpoint (>300°F)

Disadvantages
< Biodiesel has 8% less energy per gallon. Max power and miles per gallon will drop by that amount, but using a 20% blend shows almost no difference in power.
< Biodiesel is less oxidatively stable than petroleum diesel fuel. Old fuel can become acidic and form sediments and varnish. Additives can prevent this.
< Biodiesel will gel, like regular diesel fuel. Blending and additives can control this.
< Biodiesel can cause filter plugging at low temps due to polymers, fuel tank deposits, other contaminants. Filtering keeps the fuel clean.

Dr. Van Gerpen said that now is the right time for biodiesel because:
< Petroleum prices are at all-time highs.
< Federal government incentives provide excellent support:
  -< CCC program (buys feedstock for 1st year, 50% in 2nd year, 30% in 3rd year, 15% in 4th year)
  -< Federal tax credit ($1./gallon of biodiesel)
  -< Small producer credit ($0.10/gallon if less than 15 million gallons)
< Current price: $2.30 -$3.00/gallon depending on location and how much of the tax credit is passed on to the consumer.

Obstacles to the development of biodiesel industry in Idaho include:

< Risk to capital
  -< Investors are concerned about risk if petroleum prices go down, or incentives go away.
< Which comes first: Crop or processing plant?
  -< Farmers won't plant crop if there is no processor, processor won't invest if there is no crop.
< A way is needed to distribute the risk

Dr. Van Gerpen used Minnesota as a successful example of state support. In 2002 a law was passed that would not become effective until June 2005 and only if there was sufficient production capacity in the state to supply 50% of the requirement (8 million gallons/year). The current capacity in Minnesota is 65 million gallons/year. The current price of biodiesel is equal to diesel fuel so fuel with 2% biodiesel costs the same. Today, September 29, 2005, all diesel fuel sold in Minnesota for use in engines is required to contain 2% diesel.

He gave the following example of what a 2% mandate would look like for Idaho:

< Current annual diesel fuel consumption is 375 million gallons (on-highway+off-highway)
< 2% would require 7.5 million gallons of biodiesel
< At 100 gallons/acre this would provide an in-state market for 75,000 acres of canola
< Idaho canola and mustard seed oils provide superior biodiesel compared with soy oil that provides a competitive advantage

Benefits to the state would include:

< 2% biodiesel provides needed lubricity to low-sulfur diesel fuel
< Encourages a more diverse set of rotation crops for wheat
< Encourages private investment by distributing risk between plant developer, farmers, and fuel consumers
< Encourages in-state processing (oilseed crushing and biodiesel processing) to add value to a product grown in the state
< Idaho processing plants could draw raw materials from Oregon and Washington

Downsides to these benefits include:

< Federal tax incentives are only authorized to 2008
< If federal incentives go away and diesel fuel returns to $2/gallon, the 2% requirement could increase the price of diesel fuel by $0.02/gallon
< Idaho Ag ruling currently restricts canola and other brassicas in parts of Southern Idaho

In response to a question from **Senator Coiner** regarding which crops per acre would produce the 100 gallons of biofuel, **Dr. Van Gerpen** said that number is equivalent for rapeseed, canola or mustard seeds because there are varieties that yield about 40% oil content. He said that is based on a yield of about 2,200 pounds per acre of oil seed. **Senator Coiner** asked what the return to the farmer would be for this. **Dr. Van Gerpen** said that today farmers say if they get 8 to 9 cents a pound, they are lucky but that is not enough to provide an incentive to grow more. If they could get 15 cents a pound, it would be worth it to grow more, as well as to get a good value for the meal to feed dairy cows.

Representative Bolz said that he has heard that it takes a lot of energy to produce ethanol. He asked about

the relationship between producing biodiesel as compared to the energy it provides. **Dr. Van Gerpen** stated that the energy in biodiesel fuel is 3.2 times greater than all of the energy it takes to produce it. The work at the University of Idaho supports that. He noted that there is a paper that questions that number and they are looking at it. According to the findings, there appears to be some errors in that paper that need to be corrected, but the major advantage is its energy production.

Senator Schroeder asked if it is feasible for someone to produce their own biodiesel for their own energy needs. **Dr. Van Gerpen** said it is feasible to do if the economics are left out of it. He said he would not encourage it because of the infrastructure investment required. The expense is in crushing the seeds to produce the oil. Just producing the biodiesel would be much more feasible.

Following a break for lunch, **Mr. Phil Syrdal, BioIdaho,** introduced **Dr. James Nagler, Associate Professor, Department of Biological Sciences, University of Idaho.** Mr. Syrdal added that nanotechnology research is also being conducted at Boise State University using materials such as cartilage. This work helps define the nanotechnology field because it can be done in many different ways, organic or inorganic.

Dr. Nagler explained that bio-nanotechnology is based on nanoscale particles, wires and springs that are 10,000 times smaller than a human hair. The scientists are actually able to put these particles into a cell or the bloodstream.

Dr. Nagler's presentation included specific examples of research being done in this area including bioseparation and cell biolabeling using nanomagnets; biodelivery using protein-coated nanowires and cell uptake of fibronectin-coated nanowires; and gene detection and quantification using nanosprings. He explained that this last example is hoped to be used to create a reusable microarray.

Contributors and collaborators involved with bio-nanotechnology include:

< Drs. David McIlroy, Chris Berven, and You Qiang, Department of Physics, UI
< Dr. Pamela Shapiro, Department of Chemistry, UI
< Dr. Greg Bohach, Department of Microbiology, Molecular Biology, and Biochemistry, UI
< Dr. Christopher Daniels, College of Pharmacy, ISU
< Dr. Alex Punnoose, Department of Physics, BSU

Dr. Nagler said in conclusion that there are several exciting ongoing research projects and numerous applications for bioscience. He said there is a critical mass of expertise available in Idaho.

Senator Fulcher asked what the state could do to benefit research in this area. **Dr. Nagler** said that since the nature of these projects is highly collaborative, anything that can be done to reduce communication barriers between universities, colleges and medical centers to allow that collaboration to happen, would be very helpful. He said that because of the geographic diversity of the state, some research is hindered. Video-conferencing facilities would be helpful and internet communication throughout state is very important to facilitate the teamwork necessary to be successful.

Dr. James Araji, Agricultural Economics and Rural Sociology, University of Idaho discussed the impact of basic research on the development of agricultural biotechnology. He stated that investment in biotechnology is the best investment any society can make. The United States used to have the highest per

capita investment in research in the world; today we are fourth behind Malaysia, Japan and Germany. Recent investment in biofuels by England, France and Germany is higher than the United States. According to **Dr. Araji** basic research is fundamental to the development of the biotechnology industry.

Dr. Araji, using the example of the Green Revolution (1953-1980), said that research is time consuming and expensive. The benefit of hybrid corn and sorghum in employment and increased productivity was shown to have a rate of return at 750%.

He said that an estimated 349 wheat variations were released in the United States during the Green Revolution and that Idaho has been a leader in wheat variation development. Net annual benefit from continuous soft wheat variety development for dry and irrigated land is estimated at over $14.4 million. The net annual benefit from continuous development of other improved wheat cultivars for Idaho is estimated at over $16.9 million and net annual benefits from barley development is estimated over $18.5 million. Development of new potato varieties with improved recovery rates in processing is estimated at over $87 million in net annual benefits.

Dr. Araji explained that the departure from the era of the Green Revolution to the Gene Revolution began in 1980 and it focused on improving product quality, reducing chemical use and enhancing the environmental quality. Idaho adjusted to this era as follows:

- Identification of enzymes in potato peelings and cheese that are anti-cancer agents
- Mule cloning and development of stem cells with the potential of curing many types of cancer
- Successful development of vaccine to control human and animal deceases, including mastitis, caused by Staphylococcus aureus. This bacteria causes over $8 billion annual loss in the United States. This vaccine, developed by a scientist in Idaho, will significantly reduce this loss.
- Successful development of biodiesel from oil seeds. This technology was developed about 15 years ago by an Idaho scientist. It is being refined and has the potential for commercial development with significant positive net energy balance.
- Generating biodiesel, electricity and fertilizer from the estimated 5 million tons of air dry accumulated manure using biotechnology
- Idaho agricultural research can adjust further to meet the challenge of the Gene Revolution by shifting resources to basic research
- Basic research is fundamental to the development and location of biotechnology industry
- Pharmaceutical industry in the East is clustered around Harvard, Yale, Rutgers, etc.; in the West around Berkeley, Stanford, and California Institute of Technology. Agricultural biotechnology industry is located close to such research institutions as Iowa State University, University of California, Cornell.

The benefits of agricultural research to Idaho include:

- Types of research:
  - Information development research. **Dr. Araji** stated that this takes almost 30% of all research money. This money is invested in this area in order to comply with federal and state regulations as well as commodity groups.
  - Maintenance research. Research in this area must be done to maintain the productivity after the technology is developed.

- -< Applied research. **Dr. Araji** said this takes most of the research money.
- -< Basic research. This area currently only gets about 15% of the research money but **Dr. Araji** suggested more money could be shifted here. This is due to the fact that basic research is the backbone of any development.

< Research areas:
- -< Production technology
- -< Post-harvest technology
- -< Natural Resources
- -< Community/human resources
- -< Environment

< Benefits of research:
- -< State
- -< Regional
- -< Legislative district
- -< Counties
- -< Commodities

Dr. Araji's presentation software enabled him to show examples of the financial benefits that have been gained through use of technology to improve certain crops according to the categories listed above.

Representative Jones asked **Dr. Araji** to explain the project that **Dr. Araji** has written a grant for dealing with the livestock industry and odor issues. **Dr. Araji** said that Idaho's dairy industry has increased at a fantastic rate and we are number two in the West, and are fifth in the nation for milk production. This industry is very important to the state economy, but with that growth comes the problem of manure. There are an estimated 5 million tons of manure produced in CAFOs for dairy and fed beef with 2.4% of that being produced in south central Idaho. **Dr. Araji** has been working on what to do with that manure as follows:

< 1. Use manure as fertilizer to substitute for synthetic fertilizer
< 2. Try to find other ways to use manure in biotechnology
< 3. Change energy source from natural gas to manure chips

Dr. Araji said there is a power plant in Idaho that has changed from natural gas to chips and has been able to produce 6,000 BTUs per pound of chips with 40% moisture. He said most of the feed piles in Idaho range from 45% to 65% moisture. This brought up the question of whether or not manure can be burned to produce electricity. It was discovered that could be done, but there is still an odor problem. **Dr. Araji** said that there is a technology being developed that will take care of this. He said burning manure chips can replace large amounts of natural gas based nitrogen that is used to grow crops. There is support for the development of this technology from all commodity groups, the Governor's Office, the Legislature, county commissioners and large dairy owners.

Senator Fulcher asked how other countries got ahead of United States on research and development. **Dr. Araji** said that most of the R and D investment money comes from the governments of these other countries. He does not know all of the details about what industries are using or developing biofuels but

that England, France and Germany are leading in that area; the United States is number 17 in the world. **Senator Fulcher** asked where he could find the actual amount being invested in these other countries. **Dr. Araji** referred him to an article in the *Economist* magazine, an issue from about one month ago; and he offered to obtain that information for the committee.

Mr. Ray Barnes, Director of Technology Transfer and Commercialization, Idaho National Laboratory (INL), described what INL is doing to create a positive return on the great investments being made in research and development programs. He said that his organization is responsible for working with the results of INL's research programs to take the intellectual property and find ways to exploit it through partnerships, principally with commercial parties, but often with other research institutions and state and local governments. He explained that their mandate is to fulfill the investment activity by creating a positive return on the investments that, in their case, the federal government makes in research and development. He said the activity at the laboratory has become increasingly high profile as it has at all of the national laboratories, as the evolution of federal science and technology policy is clearing moving in the direction of demanding tangible results from the investments being made.

Mr. Barnes said that Batelle Energy Alliance (BEA) which took over the management of the INL a few months ago is particularly well suited for this emphasis. Consequently, in looking through the strategic plans for the laboratory, the idea of extensive partnerships is a prominent feature. These partnerships are not only in conducting the research but in exploiting the outcomes.

Mr. Barnes stated that INL currently has over 250 active U.S. patents and have, at any given time, approximately 750 open intellectual property cases including invention disclosures that are being evaluated to decide if they warrant pursuit of a patent. He said that the laboratory manages all of its intellectual property cases through a team approach that has people in his department with ties to the commercial world working closely with the research staff to define the best opportunity for creating value out of the intellectual property. There are five teams that are defined by the most likely places in the outside world where the technology would be utilized. These teams are environmental, industrial processing and manufacturing, national security, non-nuclear energy and nuclear science and technology.

Mr. Barnes explained that invention disclosures are made by researchers to the laboratory, of discoveries they believe are patentable and commercially valuable. This is the first step to commercialization. He said they have had 130 to 150 invention disclosures over the last couple of years that resulted in 65 to 75 patent applications actually being filed. He noted that historically about 2/3 of the patent applications they file result in a U.S. patent being issued.

Mr. Barnes explained that existing technology partnership tools include existing technology transfer mechanisms of:

- Cooperative Research and Development Agreements (CRADAs). These agreements are federal, statutorily-defined, collaborative mechanisms that allow the laboratory to trade resources back and forth with research partners
- Licensing and Startup Companies
- Work for Others
- Technical Assistance

Mr. Barnes said that even though this is a modestly-funded program, it has very significant impact across

Idaho. INL has authority under the Stevenson-Widler statutes to offer state and local governments and small companies free access to the laboratory's technical capabilities to conduct specific projects to address specific needs. They make available up to 40 hours of technical staff time to the requesting entities and do 30 to 50 of these small projects per year.

Mr. Barnes said that under the Batelle contract, they hope to be able to add more tools to the tool chest. Being an instrument of the federal government creates some different requirements to the way business is done. The following are BEA innovations for collaboration:

< Authorities to conduct work with industry partners on commercial terms using laboratory resources (Use Permit). This use permit would be an arrangement with the Department of Energy under which the laboratory would be able to migrate laboratory resources between private sector work and government work more fluidly. Full cost recovery would of course be made to the government for the use of these resources but it allows the laboratory to work with commercial entities on commercial terms that are much more familiar and attractive.
< Fund development of promising technologies with Battelle Corp. funds (a form of privately funded technology transfer)
< Other transactions authority would give INL license to create new partnership forms

Mr. Barnes said that spin-off activities are of particular prominence in the host region of the laboratory because the local area wants to benefit through the growth of new companies based on laboratory technology. Progress has been made in this area but it is still a challenge. Some of the realities to spin-offs include:

< Scarcity of investment capital
< Professional services infrastructure
< Availability of experienced management
< Remoteness from markets
< Expectations on how long it takes spin-off companies to develop
< Few technologies justify starting a new company to commercialize the technology

Despite these issues, some spin-offs are successful. **Mr. Barnes** noted that a company called NitroCision based in Idaho Falls, Idaho, was founded in 2001 by an experienced entrepreneur who was familiar with the DOE system. After this, they spent three more years in technical development costing a few million dollars; last year they received a $34 million contract from NASA and received a very prestigious award from NASA for the role NitroCision played in returning the space shuttle safely to space. Other successes are The NanoSteel Company, Positron Systems, and proswat.

Mr. Barnes said that the laboratory has been particularly active in education. INL is involved across the state in helping with education and economic development in order to have some positive impact on making good career opportunities in science and technology available to Idaho's next generation. These programs include:

< Governor's Science and Technology Advisory Council that supports the state of Idaho strategic plan to systematically foster technology based economic development.
    -< Idaho TechConnect and TechLaunch that are catalysts for Idaho entrepreneurs.
    -< Industry Forums
< Idaho Rural Partnerships

< Idaho Economic Development Association
< Internships - full-time internships for BYU-Idaho students
< TRAILS - an intercollegiate competition that offers senior-level business students the opportunity to conduct market research on promising INL technologies.

Senator Coiner inquired why the internships are dedicated only to a private university. It would be his hope that internships would be offered to all Idaho universities in the state in order to spread the opportunity. **Mr. Barnes** said INL tried without success to engage other universities in the internship programs in his department with the interest in giving opportunities to the best and brightest students. He noted that Boise State University has pledged to have at least one intern at INL next summer. He emphasized that the internships are not dedicated only to BYU-Idaho students. **Senator Coiner** suggested that the education committee encourage all universities to take advantage of this opportunity to allow young scientists to take part in the very progressive work that is going on at INL. **Mr. Barnes** added that he also works with business majors in his area. **Representative Rydalch** reminded the committee that this is just one segment in INL internships and that an earlier speaker spoke of internships in other areas of INL with participants from all over the country.

Mr. Barnes encouraged committee members to visit the INL website at: inl.gov/techtransfer. He said this provides the opportunity to see some of the technology available to give a better understanding of the research activities being conducted at the laboratory. Also on the website, one can find technologies available for licensing according to specified categories.

Representative Jones asked if the money is divided between the laboratory and the researcher when a technology is licensed. **Mr. Barnes** said that the laboratory has received about $850,000 in revenue from licensing activities and that 30% of that is shared with the inventors of technologies that are licensed. The bulk is available to the laboratory for use in many ways that are quite flexible. Most of it is used for additional testing of technologies that may be promising but need more research or testing.

Representative Rydalch asked about the liquid natural gas project that is taking place at INL. **Mr. Barnes** said that the technology involves a low-cost, liquefaction technology, a small footprint technology compared to the existing liquefaction technology. He explained that there are two existing natural gas liquefaction plants in U.S. They are very large industrial facilities which are not popular in communities, and they require large investments to build. The technology INL has developed will fit on two skids that can go on the back of a semi-truck and be plugged in to a natural gas pipeline to produce liquified natural gas at a close point to where it will be used, cutting down on transportation of the product resulting in lower costs. He said they are consulting with major corporations to license this technology for use in U.S. and in foreign countries.

Representative Rydalch said that it is not easy to license a technology out of a federal laboratory in order to start a business, but it is possible. She asked if there are any Idaho businesses or citizens doing this, and is there is a gap between the laboratory and getting the technology to the market place? **Mr. Barnes** responded that there are at least five Idaho companies that have succeeded and others are pending. He stated that INL is actively try to locate businesses in Idaho. Regarding the question of a gap in technology, **Mr. Barnes** said that with the occasional exception of software, almost every technology requires further investment to get to market and that the laboratory has limitations on how far they can go before a technology has to be turned over to private industry. **Representative Rydalch** asked how the state could

help fill that gap and encourage companies to do this. **Mr. Barnes** said that more commonly, across the country, the practice has been for state governments to work through tax credits rather than funding. He said it is very expensive to get technology to the market after it has been developed.

Representative Henderson said "I have heard the presentation from INL on two occasions and in both cases, the representative of INL said there is scarcity of investment capital and a shortage of managerial talent" qualified to transfer and commercialize a technology. He asked if the laboratory is only looking in-state for investments and if, when the laboratory has a technology ready for commercialization, they accompany the announcement of that technology with a competently prepared business plan so those who have money to invest can see the scope of the investment needed, an identification of the market and the number of years it will take to break even. **Mr. Barnes** answered that regarding the business plan, the laboratory does not do that. As a federal entity, they have requirements to publicize the availability of technology for licensing, but they do not dictate to which markets those technologies should go or the commercialization strategies. The prospective licensees come forward and develop the business plans. He said the laboratory looks for managerial talent in all areas of the country as well as Idaho.

Dr. Gene Merrell, Assistant Vice President-Research, and Chief Technology Transfer Officer, University of Idaho, presented the university point of view regarding technology transfer. **Dr. Merrell** explained that from his perspective, technology transfer is the processes and consequences of moving technological ideas, skills, processes, hardware, and systems across a variety of boundaries-national, geographic, social and cultural, or organizational and institutional. He said that university technology transfer is a term used to describe a formal transfer of rights to use and commercialize new discoveries and innovations resulting from scientific and engineering research to another party. **Dr. Merrell** clarified this is not the giving of ownership but a sharing of rights. A university always retains the rights to the technology to be used in instruction and research activities.

The traditional process of technology transfer in a university environment is linear. The university applies for funding for basic research. Hopefully after that funding is received, inventions are created but the ultimate outcome for the faculty member is publishing the research, generating PhDs, tenure and perhaps patents and licensing. **Dr. Merrell** explained that at the University of Idaho roughly 50% of all of the research expenditures come from federal dollars. Over the last five or six years, the largest number of invention disclosures the university has received have come from the College of Engineering followed by Agriculture and Life Sciences and then by the College of Science.

Dr. Merrell said that the university technology transfer process is constrained by laws, policy, and contractual arrangements. 37 CFR 401, commonly referred to as the Bayh-Dole Act, describes how inventions created with U.S. government funds by universities, non-profit research institutes, and small business are to be handled. Since most university research is funded, at least in part, by the federal government, these regulations form the basis of our intellectual property policies and technology transfer practices. He explained briefly that these rules dictate that the university has to require its researchers to agree in writing to disclose potentially patentable inventions that they create in the course of their federally funded research. The institution has to decide whether or not it wants to take ownership of that invention. If they do, the regulations then require that the invention has to be patented and licensed. **Dr. Merrell** said this seems the obvious course but that it may not always be the appropriate step to take. The regulations require the university to share any income generated through the licensing process with the inventors, cover patenting and marketing expenditures, and apply any remaining amounts for support of additional

research or instructional activities.

Dr. Merrell continued that if the university decides to take ownership of the invention and patents it, they are to give preferences to small businesses in the licensing of the invention, and most of the manufacturing of the product must take place in the U.S.

Dr. Merrell explained that having such a regulation to deal with is often a benefit for the university because it helps remind the faculty that they are supposed to be disclosing. The State Board of Regents and UI's policies are consistent with these regulations and seek to protect the state's investment in the resources utilized in the research activities. Industry-sponsored research contracts generally provide means for the sponsor to access technology created with their funds.

Dr. Merrell went on to discuss the challenges that all universities face in technology transfer:

< Obtaining disclosures. For a member of the faculty to submit an invention disclosure, the member must first recognize that he has created a potentially patentable or copyrightable discovery. Many faculty do not think in those terms. They may have worked in forest nutrition, for example, but never have considered the application of that technology in nurseries. Training helps. Some faculty are reluctant to submit a disclosure because they are uncertain of the process, do not trust their institution or do not believe technology transfer through licensing is an appropriate activity for an institution of higher education. These are issues we and all other research institutions face.

< Technology transfer resources. Very few technology transfer organizations break even. Patenting and personnel costs are significant. Those offices that do make significant money through their licensing program generally have hit a home run – GatorAid, taxol, MRI, etc. The UI and the Idaho Research Foundation, the UI's technology transfer agent, is developing a resource plan that should permit the foundation to hire a full time director and add a full time marketing person in the near future. This should permit the foundation to more fully manage the portfolio of technologies developed at the university. It is important to note that technology transfer offices provide non-revenue generating functions for the university such as executing material transfer agreements, confidentiality agreements and government reporting, all important activities for the research enterprise.

< Expectations. There is often the expectation, by the inventors and institution, that this activity will generate significant income for the inventors and discretionary funds for the university. As mentioned earlier, unless there is a home run, this is not likely to happen. Another expectation often is that universities should be spinning out technologies through start-up companies. Faculty start-ups are one route. Most faculty are faculty because they enjoy their university role. These are generally risk-averse individuals and starting a company is risky, both financially and professionally. Non-faculty start-ups are also a consideration. Although there are entrepreneurs in the state, most university technologies are not generally suitable for a start-up opportunity. To invest in starting a company, one would generally look for a platform technology that would form the basis for a new industry or a technology that was considered revolutionary rather than evolutionary. These are relative few.

< Embryonic technologies. The other consideration for start-ups and licensing in general is the

embryonic nature of most university technologies. Many technologies disclosed to the university are more "idea" than a finished product. Without a solid proof of concept or working prototype, there is significant risk and cost in developing the technology to a commercial stage. This high risk aspect makes it difficult to attract licensees. The federal government does not normally fund the applied science necessary to develop the proof of concept or prototype. This gap between the basic science funding that led to the discovery and the funding available from angel or venture capital group has been a struggle for all university technology transfer operations. Over the last few years, some universities have been developing gap or pre-seed funds.

Dr. Merrell continued that there are several activities currently in progress at the University of Idaho that will strengthen its technology transfer operation and assist in using university technology for economic development in the state. These opportunities include:

< Policy update. One hindrance to obtaining disclosures from faculty is uncertainty related to the university's intellectual property policies and the technology transfer process. A faculty committee has been created to update the policies and provide the clarity. In the process, we will also provide a description of the process. This should help attract more faculty to participate in the technology transfer process.

< Presidential Commission. President White created a commission to look at technology transfer at UI and prepare a set of recommendations on steps to take to strengthen this activity at the UI. Their recommendations should be presented to President White before the end of October.

< VIEW. There is a new, multidisciplinary program at UI called VIEW – Vandal Innovation and Enterprise Works. This program will involve students and faculty from the different colleges in entrepreneurial activities, both instructional and research. A business plan competition is a part of the activity. Although the program is still being developed, we have discussed using technologies disclosed to the university as team projects. The team of students would work together to develop the proof-of-concept or prototype at the same time they create a business plan. This would be an excellent opportunity for the students to work with a real situation and create value – investment grade technology with a fully developed business plan.

Dr. Merrell gave the following in response to the question of how the legislature can help this process. He explained a new technology transfer process being implemented at universities across the country, referred to as the Kansas Model:

Technologies created with federal funding are considered for gap or pre-seed funding. The technologies chosen enter the circular process below (referring to presentation slide), in which the applied research is performed with a prototype product created or the concept is proven viable. This process is called "technology incubation" as opposed to business incubation. This investment grade technology and the associated business plan is easier to license and the value does not have to be discounted due to the otherwise high risk. It can be seen that the benefits or return on the investment of gap funds is new business creation, higher paying jobs, products to benefit the public, and profits generating increased tax revenue for the state.

Dr. Merrell proposed that the state invest in a gap fund at the university that would match state funds with

private funds. The funds expended would be replenished from license income generated through the licensing of incubated technologies. A competitive process for providing gap funds will be developed and will employ both internal and external reviewers. This is an opportunity to leverage state funds in the creation of value from technologies.

Dr. Merrell listed the benefits to be derived in general from technology transfer:

< Accelerates business creation
< Creates higher value
< Spawns new businesses
< Creates new industries
< Opens new markets
< Workforce development
< New products and services that improve our quality of life

He stated that intangible benefits resulting from this would include:

< Increased invention disclosure and innovation reporting rates
< Higher value licenses-- less discounting of the financial terms of a license to compensate industry for the high risk of development
< Increased "deal flow" -- better deals, smoother transition from research to licensing phases
< Increased research in areas with commercial potential
< Improved relationships with faculty-- more internal assistance and external reality testing of faculty expectations regarding the commercial potential of their work
< Enhanced relationships with the business community
< Enhanced relationships with local and state governments resulting from working more closely with Idaho companies and venture capitalists

Senator Bunderson said that sometimes inventors are not aware that a product could be developed into the market. He asked if there are any incentives offered to researchers to do this. **Dr. Merrell** said that some institutions have this type of incentive but not in Idaho. **Senator Bunderson** asked if the distribution of money once a technology is patented or licensed, is enough. **Dr. Merrell** said that Idaho is quite generous with how money for this is distributed, with about 40% going to the inventors. The highest is 50% with the average being about 1/3 that gets shared with inventors. He noted that many times these people are not aware this money is available and that an education process needs to be developed.

Representative Jones said that the University of Idaho is the largest in Idaho in terms of research and in patenting. He asked if other universities can contract with the UI for help in this area, or can UI share the information? **Dr. Merrell** said that the university has agreements in principle but those have been put on hold pending presidential recommendations.

Representative Rydalch asked, regarding further development of a technology, if there is help available for inventors in terms of finding other grants. **Dr. Merrell** said yes there is, but his experience is that most faculty are not interested in starting a business so it has been very difficult. Most people are faculty because that is what they are good at. **Representative Rydalch** added that there are grants available for universities from the federal government for prototype development.

Representative Jones noted that any written comments submitted by the private sector regarding the private technology transfer process would be included as an attachment to the minutes.

Dr. Michael Phillips, Vice President, Food and Agriculture Science and Regulatory, Biotechnology Industry Organization (BIO) and Mr. Ab Basu, Director, State Government Relations, BIO, Washington D.C, were introduced to discuss the promise of biotechnology and Idaho's role.

Dr. Phillips explained there is growing interest in biotechnology because the potential of bioscience technologies to improve human health, agriculture and nutrition as well as preserving and improving our environment has gained significant recognition world wide. He said that many states and countries have put in place initiatives to improve the economic and regulatory climate in order to facilitate bioscience industry development.

Dr. Phillips said there are clearly some industry focal points that can affect the development of the biotechnology industry including:

< Intellectual Property Protection
< Technology Transfer
< Capital Formation
< Bioethics
< Drug Safety
< Reimbursement
< Agricultural Biotech
< Industrial Biotech
< BioSecurity

He said that they have learned as an industry that evolution dictates focus. Concern about public policy issues in the bioscience industry varies widely depending on the stage of evolution. Early stage companies tend to focus on issues like IP protection and access to capital. Later stage companies are more concerned with issues like regulatory burden, tax policy and reimbursement.

Dr. Phillips informed the committee that a study BIO did with Battelle on what is going on throughout the U.S. in terms of bioscience initiatives is available on their website at: www.bio.org. The findings show there are 885,000 people, located in over 17,000 companies across all 50 states, employed in the biosciences – a figure significantly surpassing previous efforts to track the industry. Forty states are now targeting biosciences today compared to 14 states in 2001; many are strategically targeting specific niches, based on their research and industry strengths, as for example, biomanufacturing.

Subsectors of bioscience include:
< Agricultural Feedstock & Chemicals (17%)
< Drugs & Pharmaceuticals (33%)
< Medical Devices & Equipment (37%)
< Research & Testing (13%)

According to **Dr. Phillips,** the following table shows that biotechnology is an area of high salaries and requires people with experience and education. This table shows growth, between 2001-2003, in these

various subsectors.

Subsector	# of Companies	# of Employees	Avg. Salary	% Growth
Agriculture	3,337	153,581	$55,261	-7.5%
Drugs and Pharmaceuticals	2,511	291,268	$73,731	0.04
Medical Devices	6,175	322,881	$52,000	-2%
Research and Testing	5,000	117,638	$73,500	0.01

In his opinion, there is considerable rationale for state interest. These reasons include:

< The fact that investment in bioscience can lead to improving health care, a cleaner environment, and healthier foods.
< The fact that biosciences are expected to grow at faster rate, in the next decade, than any other industry sector – *13% greater than average growth rate for overall U.S. employment.*
< Biosciences provide a wide breadth of opportunities in the various subsectors.
< Biosciences offer high-skill, high-wage jobs across a range of occupations - *$26,000 (US) more than the national average for the entire private sector*.

Dr. Phillips went on to say that another reason to focus on biosciences is because the bioscience industries provide stability: demand for medical-related and food products remains fairly constant year after year, and bioscience offers employment opportunities across the spectrum of experience and responsibility. He reminded the committee that there is a multiplier effect, meaning many other jobs will also be created to support the bioscience industry.

Dr. Phillips listed some of the industry drivers as follows:

< Talent
  -< Chief Scientists and Technologists
  -< Bench Scientists and Engineers
  -< Technicians
  -< Serial Entrepreneurial Managers (Regulatory, Sales and Marketing, Quality Control)
< Capital
  -< Angel Investors
  -< Pre-Seed/Seed
  -< Venture Capital
  -< Working Capital
< Technology
  -< Infrastructure
  -< Research Engines
    C Higher education
    C Hospitals and academic heath centers
    C Research anchors

< Quality of Life
  -< Talent drives firm growth
  -< Family issues; it is not just what young singles desire

Dr. Phillips admitted that the capital financing needs are great and the chart below shows the various stages a company will go through from proof of concept until the product is successfully launched.

Company Stage	**Private investment per company**
Proof of Concept	$25,000 – $100,000
Pre-seed	$50,000 – $500,000
Seed	$150,000 – $2 million
Early-stage	$1 million – $5 million
Expansion-stage	Up to $10 million
Mezzanine	Up to $20 million

Successful Product Launch: **10-15 years - $1 billion**

He said along with this, there are a number of federal public policy issues including medicare and medicaid reimbursement, tax policy, SBIR eligibility, stem cell research, intellectual property, drug safety issues and agriculture issues. At the state level, public policy issues are medicaid reimbursement, importation, stem cell research, agricultural issues and capital formation. Capital formation on the state level is extremely important. Although many states are working diligently to accommodate bioscience industry needs, there are numerous public policy issues being considered that could seriously impact industry development in the U.S.

Dr. Phillips discussed agricultural biotechnology. He stated that biotechnology has revolutionized production agriculture. Worldwide, there are now 1 billion acres of biotechnology crops in production. Major commodity crops, including corn, soy, canola and cotton, are now predominantly biotechnology varieties. These crops contain traits to either resist pests and/or be herbicide tolerant with the intent to reduce chemical inputs and increase yield.

Dr. Phillips said that a study BIO had commissioned one year ago showed that the impact on agriculture has allowed for the use of 46 million pounds less of pesticide per year, a four billion pound increase in the production of food and fiber, and over $1.5 billion in increased income.

In the food and feed arena, they are preparing for the next generation of products. These products will have the attributes of better flavor, color, texture, extended freshness, improved processing characteristics, enhanced nutritional profiles (vitamins, nutrients, proteins and fats) as well as decreased allergenicity.

Dr. Phillips said there is another new area where "ag meets pharma." This technology is used to manipulate proteins in food to create the ingredients for therapeutic drugs. This is creating opportunity for production agriculture that has not existed before. He noted that there is concern in this area from commodity groups and food manufacturers about the potential for co-mingling that cannot be taken lightly. There are currently very stringent regulations regarding co-mingling. He said this is an area that Idaho would have to consider if this is decided to be an area for development of an industry.

Dr. Phillips said there are a number of companies in this business including:

< Chlorogen
< Planet Biotech
< SemBioSys
< Medicago
< Ventria BioScience
< Dow/Dow Agro Sciences
< Epicyte
< Meristem Therapeutics
< ProdiGene
< Syngenta
< Biolex
< Dupont
< Bayer CropScience

The accomplishments made by these companies to date include:

< Industry reference document for confinement and development of PMP in the US (May, 02)
< Outreach to stakeholders (medical health, agri /food/feed/fiber chain, academics)
< Education: fact sheets, Q&As
< Pew Public Forum (July, 02)
< Industry reference document on contingency plans, e.g., sentinel testing, validated detection assays
< Confinement Analysis Critical Control Point (CACCP) approaches for PMPs

Dr. Phillips touched on the area of industrial biotechnology. He said it employs the techniques of biotechnology to improve and reduce the environmental impact of industrial manufacturing. As was discussed earlier, this area includes bio-based fuels and nanotechnology in addition to novel polymers, biocatalysts and industrial enzymes.

Dr. Phillips said that in looking forward, there are key issues in food and agriculture that BIO is concerned about and where BIO is focusing most of its activities.

< Adventitious Presence. He explained this means that nothing is pure, but this technology must meet a tolerance standard of zero. If there is an unauthorized variety produced, it cannot enter the food supply in any way. Until policy can be developed regarding ag biotechnology to allow some level of impurities into the system, there will be problems. He said the U.S. is moving toward that policy. It will be challenging to get that approved overseas.

< BioSafety Protocol. This is an environmental agreement being worked out among countries could cause trade disruptions if it is not done right.

< USDA/APHIS Regulatory Reform

< Animal Biotechnology Regulatory Policy

< Coexistence/Liability

< State Issues

Dr. Phillips introduced **Mr. Ab Basu,** also from BIO, to discuss what is happening in the states throughout the U.S. **Mr. Basu** said that about five to six years ago, it was found there were a growing number of environmental and organic activist groups which were not believing in the promise of biotechnology. This led to the introduction of legislation to ban certain biotechnologies until more study was done. This legislation has been very harmful to grower groups and to the industries within these states dealing with biotechnology. He did say much of the legislation has not been successfully enacted during the past few years, but it has taken resources, time and money to counter these negative challenges to ag biotech.

Mr. Basu said one of the challenges involves increased liability standards for biotech manufacturers and growers. This has been seen in legislation requiring strict liability for seed manufacturers. "Strictly liable" is the legal term meaning the manufacturer would be liable no matter where along the chain the product is used if there is any type of loss or misuse. This has a decidedly chilling effect on progress.

Labeling of foods with genetically-manufactured (GM) ingredients has been a rallying cry for activists groups that have a problem with the biotechnology industry. He said biotechnology supporters continuously point to the federal FDA rules on food labeling.

Mr. Basu said that other challenges for biotechnology include restrictions on animal biotechnology products and animal cloning restrictions.

He pointed out that most of this legislation deals with the biomedical side and involves the pharmaceutical industry, health care providers, patient groups and others who are impacted by this issue. Agricultural biotechnology includes some very large seed companies and grower groups who work closely with the Farm Bureaus, commodity groups and Departments of Agriculture.

Mr. Basu explained that local governments regulating biotechnology have also been a problem. BIO is therefore very appreciative of Idaho's passing a law which prevents local governments from instituting bans. He noted that this legislation was chosen by CSG as a national model bill**.** There are 13 states that have passed similar legislation in the last twelve months based on Idaho's language. NCSL and CSG both took a position endorsing the uniformity concept.

Mr. Basu said that in the past several years, numerous states have put in place strategies and incentives to grow vibrant life science clusters. These programs run the gamut from building facilities for early stage company development to establishing capital access funds. Their presentation includes specific examples of what other states have done in this area.

Approaches to addressing risk capital include:

< Use state general and pension funds to invest in privately-managed venture funds
< Offer state assistance to firms to leverage federal SBIR funds
< Provide technical assistance to companies to better access private financing sources
< Offer R&D tax credits
< Form pre-seed/seed or later stage funds

State capital formation priorities include:

< Research and Development Tax Credits
< Tax Credit Transferability
< Sales and Use Tax Exemptions
< Creation of Capital Access Funds
< State Pension Fund Investment
< Capital Gains Tax Reductions
< Investment Tax Credit
< Developing Incubator/Shared Research & Manufacturing Facilities

Mr. Basu said if there were questions regarding any of these tax issues, BIO would be happy to provide further information and specific information from the states where these have been used.

In reviewing specific examples of what other states have done, **Mr. Basu** said that when people think about agriculture in Idaho, they tend to think about specialty agriculture or high management and high maintenance types of crops. Idaho is well known for having farmers that are well educated and have a lot a history, management skills and expertise raising these types of crops for specialty markets. He noted that this puts Idaho in a good position to be a leader in the industry in development of ag biotechnology.

Dr. Phillips spoke to the issue of what are the best practices for states.

Factors of Success	Best Practices States/Regions
Engaged Universities with Active Leadership	* Universities are engaged in economic development and committed to technology transfer * Have created vehicles for technology commercialization
Discretionary R&D Funding	* Every major technology region in the U.S. has received significant federal discretionary funding * In these regions, one or more federally designated centers serve as the anchor for the state or region's bioscience base

Specialized Facilities and Equipment	* Leading bioscience regions have private markets that provide facilities offering space for bioscience companies * Specialized bioscience incubators and research parks are a growing trend * Access to specialized facilities and equipment, such as core labs and animal facilities, is readily available
Talent Pool	* Talent increasingly provides the discriminating variable for states and regions to build comparative advantage * Educational institutions at all levels are responsive to training students to meet the needs for bioscience workers at all skill levels including scientists, technicians and production workers
Available Capital	* Some states and regions have created programs to address the commercialization, pre-seed, and seed financing gaps to help establish and build firms * Active informal angel networks investing in the biosciences * Investors include private, philanthropic, and public entities
Patience and Long-term Perspective	* Building a critical mass of bioscience firms takes many years or even decades * While the early technology pioneers took 25 years to develop, more recent examples such as Maryland and San Diego took 12 to 14 years to mature

* Means that Idaho has that practice available.

Dr. Phillips concluded BIO's presentation by stating that biotechnology has the potential to be the most transformational technology in human history. It is currently revolutionizing healthcare, agriculture and industrial manufacturing. The bioscience industry is dedicated to encouraging continued research and development of innovative treatments and products to improve the human condition, our environment and our way of life.

He said Idaho can play to its strengths. The state has a high quality, sophisticated agricultural industry which makes it unique. Idaho has been known for that due to its history and the fact that specialized contracts have been used here for many years. Diversified agriculture is another strength of the state and one that can easily adapt to agricultural biotechnology specialty market needs, and Idaho has a pro-industry track record. In addition, Idaho has engaged universities with active leadership, available capital, talent pool, specialized facilities and equipment, and patience with a long-term perspective.

Dr. Phillips suggested the following strategies be used in going forward:

- Develop economic incentives to attract industry
  - R&D tax credits
  - Sales and use tax exemptions
  - Investment tax credit
  - State pension fund investment
- Develop incubator/shared research & manufacturing facilities
- Develop a center of excellence in agricultural biotechnology

Representative Jones thanked **Dr. Phillips and Mr. Basu** and stated that their presentation included the longest and most complete list of suggestions of what this committee might recommend to the legislature or think about for its next meeting.

Senator Fulcher asked for more comment regarding the handling and protection of intellectual property. **Dr. Phillips** answered that the U.S. respects intellectual property law but other parts of world do not share the same level of integrity. He noted that without enforcement of protective laws, companies are pulling products from countries because they are copying it without paying for it. The U.S. government is also beginning to deal harshly with these countries.

Representative Bolz stated that society accepts biotechnology advances in medicine but not in agriculture. He asked whether it will be possible to change this attitude. **Mr. Phillips** agreed with that observation and said that it is especially true in Europe. There is a general perception of sophistication in the medical field. He noted that biotechnology in agriculture in the U.S. is becoming more accepted and even in Europe, inroads are being made. The real challenge in Europe is with food crops that have been genetically engineered, mainly wheat and rice. In Idaho, though, there is an existing respect for agriculture, making it easier to accept agricultural advances.

Senator Bunderson stated that there is an expectation that the INL will be the premier research facility for atomic energy. He asked how the state can develop that. **Dr. Phillips** said that in his opinion the increase in energy prices will help people become interested in different types of energy technology. He noted that atomic energy plants that were put in place before the moratorium are running without incident. **Dr. Phillips** said at some point fossil fuel is going to run out and alternatives are going to have to be found to replace it. **Senator Bunderson** asked if there is anything states can do to encourage growth and opportunity of those national laboratories or do they have to rely on what the federal budget appropriates to them. **Dr. Phillips** responded he did not think the federal government would establish additional national laboratories. He said that it is best for states with existing laboratories to work in tandem with whatever the national laboratory is researching. **Senator Bunderson** suggested the state encourage atomic energy generation in Idaho in cooperation with the INL as opposed to putting in coal fired or natural gas

plants. **Representative Jones** said that would be good for discussion at the next meeting.

The next meeting was scheduled for **November 1, 2005.**

Senator Schroeder said the November meeting will include discussion of recommendations to be made to the legislature or other action items. If task force members have recommendations for the next meeting, they should bring them forward at that time for introduction and committee discussion. He also suggested any motions should be written out and information be ready to present.

The meeting was adjourned at 5:05 p.m.

Copies of PowerPoint presentations are available upon request from Legislative Services Office, State House, Boise, Idaho.